CLAIMS

We claim:

1. A light emitting device having a stack of layers including semiconductor layers comprising an active region, said device comprising:

a transparent optical element bonded to said stack.

2. The light emitting device of claim 1, wherein said optical element comprises an optical concentrator.

3. The light emitting device of Claim 2, wherein said optical concentrator comprises a parabolic wall.

4. The light emitting device of Claim 2, wherein said optical concentrator comprises a cone-shaped wall.

5. The light emitting device of Claim 2, wherein said optical concentrator comprises a beveled side wall.

6. The light emitting device of Claim 2, wherein said optical concentrator comprises a side wall coated with metallization.

7. The light emitting device of Claim 2, wherein said optical concentrator comprises a side wall coated with a dielectric material.

8. The light emitting device of claim 1, wherein said optical element comprises a total internal reflector.

9. The light emitting device of Claim 1, wherein said optical element is formed from a material selected from the group consisting of optical glass, III-V semiconductors, II-VI semiconductors, group IV semiconductors and compounds, metal oxides, metal fluorides, diamond, yttrium aluminum garnet, and combinations thereof.

10. The light emitting device of Claim 1, wherein said optical element is formed from a material selected from the group consisting of zirconium oxide, sapphire, GaP, ZnS, and SiC.

11. The light emitting device of Claim 1, wherein said optical element includes one or more luminescent materials that convert light of a wavelength emitted by said active region to at least another wavelength.

12. The light emitting device of Claim 1, wherein said optical element is coated with one or more luminescent materials that convert light of a wavelength emitted by said active region to at least another wavelength.

13. The light emitting device of Claim 1, wherein said optical element is bonded to a surface of said stack, and wherein a smallest ratio of a length of a base of said optical element to a length of said surface is greater than about one.

14. The light emitting device of Claim 13, wherein said ratio is greater than about two.

15. The light emitting device of Claim 1, wherein said stack is located in a recess of a surface of said optical element.

16. The light emitting device of Claim 1, wherein a refractive index of said optical element for light emitted by said active region is greater than about 1.5.

17. The light emitting device of Claim 16, wherein said refractive index is greater than about 1.8.

18. The light emitting device of Claim 1, wherein a refractive index of said optical element is greater than or equal to a refractive index of said semiconductor layers for light emitted by said active region.

19. The light emitting device of Claim 1, further comprising contacts electrically coupled to said semiconductor layers to apply a voltage across said active region.

20. The light emitting device of Claim 19, wherein at least one of said contacts is highly reflective for light emitted by said active region and is located to reflect said light toward said optical element.

21. The light emitting device of Claim 1, further comprising at least one beveled side located to reflect light emitted from said active region toward said optical element.

22. The light emitting device of Claim 1, further comprising at least one layer highly reflective for light emitted by said active region located to reflect said light toward said optical element.

23. The light emitting device of Claim 1, wherein said transparent optical element is directly bonded to at least one of said semiconductor layers.

24. The light emitting device of Claim 1, wherein said stack comprises a transparent superstrate layer disposed above said semiconductor layers and directly bonded to said optical element.

25. The light emitting device of Claim 24, wherein said superstrate layer has a refractive index for light emitted by said active region greater than about 1.8.

26. The light emitting device of Claim 24, wherein said superstrate layer is formed from a material selected from the group consisting of sapphire, SiC, GaN, and GaP.

27. The light emitting device of Claim 24, wherein said optical element comprises one of ZnS and sapphire, said superstrate comprises one of SiC, GaN, and sapphire, and said semiconductor layers comprise a III-Nitride semiconductor.

28. The light emitting device of Claim 27, further comprising a first contact and a second contact electrically coupled to apply a voltage across said active region; said first contact and said second contact disposed on a same side of said stack.

29. The light emitting device of Claim 24, wherein said optical element is formed from GaP, said superstrate is formed from a III-Phosphide material, and said semiconductor layers comprise III-Phosphide semiconductors.

30. The light emitting device of Claim 29, further comprising a first contact and a second contact electrically coupled to apply a voltage across said active region; said first contact and said second contact disposed on a same side of said stack.

31. The light emitting device of Claim 29, further comprising a transparent bonding layer disposed between said optical element and a surface of said stack, said transparent bonding layer bonding said optical element to said stack.

32. The light emitting device of Claim 31, wherein said transparent bonding layer is formed from a material selected from the group consisting of optical glass, chalcogenide glass, III-V semiconductors, II-VI semiconductors, group IV

semiconductors, organic semiconductors, metals, metal oxides, metal fluorides, yttrium aluminum garnet, phosphides, arsenides, antimonides, nitrides, and combinations thereof.

33. The light emitting device of Claim 31, wherein said transparent bonding layer includes one or more luminescent materials that convert light of a wavelength emitted by said active region to at least another wavelength.

34. The light emitting device of Claim 31, wherein said bonding layer has an index of refraction greater than about 1.5 for light emitted by said active region.

35. The light emitting device of Claim 34, wherein said index of refraction is greater than about 1.8.

36. The light emitting device of Claim 31, wherein said bonding layer has a thickness less than about 500 Angstroms.

37. The light emitting device of Claim 31, wherein said surface includes a surface of one of said semiconductor layers.

38. The light emitting device of Claim 31, wherein said surface includes a surface of a transparent superstrate layer disposed above said semiconductor layers.

39. The light emitting device of Claim 38, wherein said superstrate layer has a refractive index for light emitted by said active region greater than about 1.8.

40. The light emitting device of Claim 38, wherein said superstrate layer is formed from a material selected from the group consisting of sapphire, SiC, GaN, and GaP.

41. The light emitting device of Claim 38, wherein said optical element comprises one of ZnS and sapphire, said superstrate comprises one of SiC, GaN, and sapphire, and said semiconductor layers comprise a III-Nitride semiconductor.

42. The light emitting device of Claim 41, further comprising a first contact and a second contact electrically coupled to apply a voltage across said active region; said first contact and said second contact disposed on a same side of said stack.

43. The light emitting device of Claim 38, wherein said optical element is formed from GaP, said superstrate is formed from a III-Phosphide material, and said semiconductor layers comprise III-Phosphide semiconductors.

44. The light emitting device of Claim 43, further comprising a first contact and a second contact electrically coupled to apply a voltage across said active region; said first contact and said second contact disposed on a same side of said stack.

45. A method of bonding a transparent optical element to a light emitting device having a stack of layers including semiconductor layers comprising an active region, the method comprising:

elevating a temperature of said optical element and said stack; and

applying a pressure to press said optical element and said stack together, thereby bonding said optical element to said stack.

46. The method of Claim 45, wherein said temperature is elevated to less than about 500°C.

47. The method of Claim 45, further comprising disposing one or more high diffusivity materials between said optical element and said stack.

48. The method of Claim 45, further comprising doping at least one of said optical element and said stack with a high diffusivity material.

49. The method of Claim 45, further comprising disposing a layer of a transparent bonding material between said optical element and a surface of said stack.

50. The method of Claim 49, wherein said bonding material comprises an optical glass, and wherein said temperature is elevated to about a strain point temperature of said optical glass.

51. A light emitting device having a stack of layers including semiconductor layers comprising an active region, said device comprising:

an optical element bonded to said stack; and

a first contact and a second contact electrically coupled to apply a voltage across said active region;

wherein said stack of layers comprises at least one III-Phosphide semiconductor layer and said first contact and said second contact are disposed on a same side of said stack.

52. The light emitting device of Claim 51 wherein said optical element comprises GaP.

53. A light emitting device having a stack of layers including semiconductor layers comprising an active region, said device comprising:

an optical element bonded to said stack; and

a first contact and a second contact electrically coupled to apply a voltage across said active region;

wherein said stack of layers comprises at least one III-Nitride semiconductor layer and said first contact and said second contact are disposed on a same side of said stack.

54. The light emitting device of Claim 53 wherein said optical element comprises one of ZnS and sapphire.

55. A method of creating a light emitting device comprising a stack of layers including semiconductor layers and an optical concentrator, said method comprising:

bonding a block of transparent optical element material onto said stack of layers including semiconductor layers; and

forming said block of transparent optical element material into said optical concentrator.

56. The method of Claim 55, wherein said bonding comprises:

elevating a temperature of said optical element and said stack; and

applying a pressure to press said optical element and said stack together.

57. The method of Claim 55, wherein said forming comprises an etching technique.

58. The method of Claim 57, wherein said etching technique is selected from one of dry etching and wet etching.

59. The method of Claim 58, wherein said dry etching is one of plasma etching, reactive ion etching, and chemically-assisted ion beam etching.

60. The method of Claim 55, wherein said forming comprises a lithographic technique.

61. The method of Claim 60, wherein said lithographic technique is selected from a group consisting of photolithography, electron beam lithography, ion beam lithography, X-ray lithography, and holographic lithography.

62. The method of Claim 55, wherein said forming comprises a mechanical technique selected from a group consisting of milling, focused ion beam milling, ablating, machining, sawing, stamping, and scribing.